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ABSTRACT

Educational objectives and practices related to computer technology in the Hessen (Federal Republic of Germany) schools are outlined, with an emphasis on secondary education. For the past decade, a new school subject, informatics, has been promoted by the State Ministers of Education and Cultural Affairs. Objectives are to provide students with a familiarity with algorithms and their programming, insight into construction and functioning of a computer, and knowledge of the applications and effects of informatics. In Hessen, information technology is currently treated as a separate subject only in certain branches of schools, because of the need for teacher training and considerable investment costs of equipment. However, over half of the gymnasiums and vocational schools and 26 percent of the comprehensive schools have computer equipment. Informatics is considered a school subject for senior gymnasiums and can be chosen as the third or fourth subject in the University Entrance Examination. Informatics classes are also offered in some junior high schools. Vocational schools stress the use of computers as tools for data processing and programming and for job training in the business sector. The future tasks of the State of Hessen will be to develop relevant teaching courses and to provide schools with contemporary equipment. (KC)

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COMPUTER APPLICATION IN SCHOOLS

EXPERIENCES IN HESSEN

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Paper prepared for the Annual Conference of the Social Science Education Consortium, Inc., (20th, Athens, GA, June 8-11, 1983).

Ladies and Gentlemen,

The fact that an everincreasing number of both teachers and pupils acquire home-computers privately and wish to use these as teaching aids indicates that the effects of micro electronics have spread as far as the school sector. This 'privatization' of information technology commenced years ago on a wide scale with the introduction of pocket calculators and is now continuing with the purchase of home and personal computers.

More than anyone else, adolescents have been very interested in information technology and understand how to both acquaint themselves quickly with the apparatus and how to learn how to operate it. A glance into a school's computer class room will show just how involved, aims-oriented and tenacious the pupils are in their approach to computers even in their free periods.

The outstanding achievements that pupils are capable of are illustrated by the projects pupils annually enter in the 'Youth Research' competition. In this competition, which takes place for the 18th time this year, national and state winners are judged in different project areas.

The Hessen Ministry of Education was able to award prizes to two groups concerned with computer technology. One group had managed, using only simple aids, to construct a computer graphics system for the blind. In order that this project could actually be sure to be useful for the target group, the pupils worked very closely with blind people from the outset. An impressive example, I feel, of technical and yet also of social 'involvement' by young people.

I wish with these introductory remarks to draw your attention to two aspects of computing in schools:
Independently of any educational-political measures, of which I shall speak below, information technology is gradually gaining ground in schools via individual initiatives taken by teachers, pupils and parents. The effects of micro electronics on the private sphere in this fashion touch tangently upon everyday schooling. Those responsible are thus faced with the question as to in which ways obvious gaps in a school's equipment can be filled by modernization and installation policies.

On the other hand pupils show astonishing motivation, creativity and a preparedness to learn in their involvement with computers at schools. The oft-mentioned 'distance from technology' is, at least here, hardly noticeable. However, parents and pupils do not expect just games from the application of computers, but rather - and justifiably - up to date, and in view of the difficult situation on the labour market, increasingly job-oriented contents to the lessons.

Introduction to the School Subject: Informatics

The effects of recent information technology on the professional and employment worlds, on science and on the economy cannot and must not remain without consequences for the educational sector. For example, since 1972 the Standing Conference of State Ministers of Education and Cultural Affairs has been trying to influence the promotion and the formation of the new school subject of informatics. In the Federal Republic of Germany this subject is given a key role in adjusting the canon of subjects to the needs of a highly technologized society. In the meantime, informatics has become an independent and regular teaching subject in Senior High Schools (with the exception of Schleßwig-Holstein and with restrictions in Hessen).

Although the concrete development of informatics as a subject was made on a state level and was furthered by school- or prototype trial projects, a consensus at federal level has now been reached both on the knowledge to be communicated by this subject and on the departmental independence of informatics.

From the clarifying process of the last ten years the following aims can now be judged as fundamental to informatics:
- a familiarity with algorithms and their programming
- an insight into the construction and functioning of a computer
- a knowledge of the applications and effects of informatics.

Informatics lessons based on the above presumptions are expected to promote the following abilities in the pupils:
- ordering and organizing abilities, such as find expression in planned and systematic work
- precision in thought and formulation
- creative thought and a concordant problem-solving ability
- algorithmic thought, oriented towards both procedures and transformational structures
- structured thought, i.e. the ability to recognize structures within complex constructions
- self control, i.e. a constructive and critical attitude towards one's own activity.

Not only schools offering a general education but also vocational schools lay particular emphasis on mediating precisely these abilities. These abilities count as the basic training, to which, according to the type of school, a further, e.g. job-oriented (program) training can be added.

In the vocational school sector the contents of data processing/informatics are suggested by Federal Guidelines and are laid down in the curricula for each particular sphere of job training or type of school. The present suggestions on the curricula and the guidelines differentiate between the demands of business schools and of technical and engineering

schools within the vocational school sector. The different forms of the application of micro electronics in, on the one hand office organization and communication, and on the other in technology,in design and construction necessarily lead to a different choice and weighting of the contents and aims of teaching.

Educational-political measures are not, however, restricted to the introduction of informatics as a school subject. The technical and social changes following in the train of modern information technology are so wide and far-reaching that young people cannot acquire the tools on which to base their chances for a future life by relying solely on the contents of one subject.

Micro Electronics in Other Subjects

In Hessen certain contents and methods of data processing and their application and social relevance can be taught outside informatics as a separate subject, namely in other subjects, types of schools and school levels, as for example:

- in the subject Polytechnics, which is supposed at an early date to communicate a knowledge of and a relation to the world of employment to pupils in Junior High Schools
- in the optional compulsory subjects in Junior High School, which schools can use for such a self-chosen range of subjects
- in Mathematics at both levels of High School, a subject in which computer use is wide-spread as a motivating enrichment of the lessons
- in Social Studies, where in particular discussions of the consequences of micro electronics (e.g. the question of data protection) can be conducted.

Pointing thus to this diversification of possibilities may perhaps present a false impression of actual school practices. Information technology has up till now only been treated as a topic in certain branches of the schools and most certainly not in all schools.

Two reasons are particularly determining in this context:

- teachers for the area of information technology can only be trained sporadically. Owing to the low number of new recruitment of teachers in the 1980s teacher training in this area will hardly lead to improvements.
- the schools can only gradually be equipped with the necessary computer apparatus because of the considerable investment costs entailed.

Equipping Schools with Computer Technology

It is generally assumed in the Federal Republic of Germany that a lesson in informatics misses its point if the pupils cannot undertake practical work at a computer.

In the last five years contributions by the State of Hessen, the district school financers and the parents' associations have enabled most schools with a Senior High School to install computer classrooms. Whilst in 1977 only 117 'Gymnasiums' (i.e. High Schools), Comprehensive Schools and Vocational Schools had at least one computer, by the end of 1982 231, 47 % of these schools, can employ computers for teaching purposes.

As a percentage of the total number of schools in Hessen for the above schools the following figures can be arrived at:
- 62 % of the 'Gymnasiums' and in all 71 % of Senior High Schools have their own computer
- 26 % of the Comprehensive Schools are equipped with computers, and in those cases where these schools have a Senior High School, almost all of them possess a computer
- 53 % of the Vocational Schools are equipped with computers, whereby almost all Vocational 'Gymasiums' and Senior Technical Schools have computers.

'Gymnasiums' Comprehensive Schools Vocational Schools

Fig. 1: Equipment of schools with computers in percentages

These figures alone say little about the usefulness of computer systems in lessons. In Vocational School classes there are frequently up to 28 pupils and, in schools offering a general education, the voluntary work groups and beginners courses have between 15-20 pupils. To actually enable these pupils to undertake the necessary interactive studies with a computer, several people must be employed to run the computer. In Hessen we strive, taking pedagogic requirements and financial resources into account, to employ one such person for every 2 - 4 pupils. Schools that already dispose over computers have on average 4.5 such people.

Type of School	Average Number of People Employed on the Computer
Total	4.5
'Gymnasiums'	4.3
Comprehensive Schools	2.7
Vocational Schools	5.6

Table 1. Average number of jobs on the computer in schools with computing equipment.

To introduce pupils to a programming language BASIC is preferred.

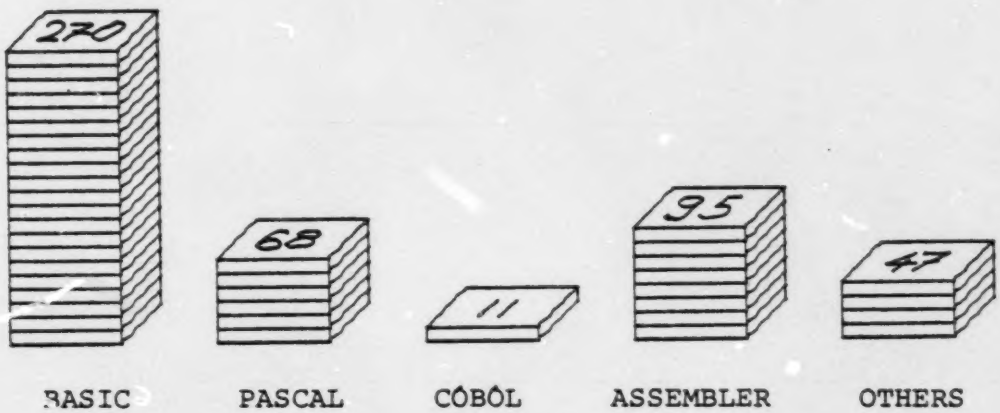

Fig. 2: Programming languages used in lessons in absolute numbers; the numbers refer to the total number of existing computer systems (331).

Computer Applications in Schools offering a General Education

In Hessen informatics is considered a school subject for Senior 'Gymnasiums' (according to Law of 11th June, 1982). It belongs to the field of mathematics and natural sciences and can be chosen as the third or fourth subject in the 'Abitur' (University Entrance Examination).

Up till now the Minister of Education has granted, at their own request, permission to 15 schools to undertake school trial projects in Informatics. The schools were thus able for the duration of a 4-semester basic course in Informatics (12/1 to 13/2), to test the following design of a course-structure plan for informatics.

The development in Hessen of informatics teaching generally was predominantly influenced by two prototype trial projects:
- PROKOP ('Computers as an aid for the pupil in active learning - a project to test problem-oriented computer use

in cooperation with teachers')
- IDA ('Integrated Application of Data Processing in schools')

On the basis of the experiences gained in this prototype trial projects and the materials produced for them it was possible to further the use of computers in teaching in all schools possessing a computer. After all, 120 of these schools offer Informatics classes in the form of voluntary work groups or as an optional compulsory subject in Junior High School.

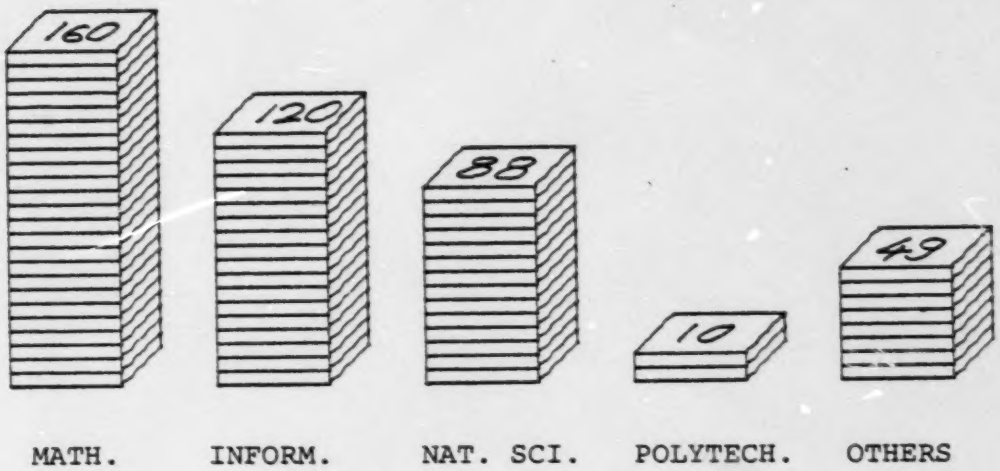

Fig. 3: Number of schools according to subject-specific computer use.

Subjects	Junior High	Senior High
Mathematics	87	141
Informatics	60	107
Natural Sciences	46	82
Polytechnics	9	7

Table 2: Number of schools according to subjects, in which computers were used.

Computer Application in Vocational Schools

More than half the Vocational Schools are able to use computer technology in career-oriented teaching. Nevertheless, many schools lack the prerequisite hard- and software if they are to keep pace in the lessons with changes in technology. In those cases in which computers and micro processors can be used to realize the teaching aims prescribed in the curricula, the following main points dominate in terms of methods:
- the use of computers as tools (predominantly with BASIC, occasionally with PASCAL, COBOL or FORTRAN) with which to mediate the fundamentals of data processing and programming knowledge

- the application of computers as an aid in problems in wage- and finance accounting, in stocktaking, in statistics, of design in engineering production, and of hotel billing etc.; by means of commercially-acquired programs or ones produced at the school. Data from these areas can be worked on by pupils at visual display terminals.
- the computer as an aid in the simulation of both commercial applications ("teaching office") and of planning games in business and economic decision-making
- teaching programs for practice and autodidactic work are offered with the computer (computer-assisted teaching)
- computers are used as a tool in technical functions for both control and regulatory procedures. With the transition from 'mechanics to electronics' from 'analogue- to digital technology' the job-oriented Vocational Schools have increasingly conveyed teaching aims on hardware (micro electronics, measurement technology) and control computer technology to their pupils.

So far computers have been applied in job training for the business sector and in the technological professions (e.g. information technicians) as well as in Business 'Gymnasiums' predominantly with the emphasis on 'Technology' and 'Economics and Administration'.

Ladies and Gentlemen, if I were to summarize briefly the experiences made in Hessen of including information technology in the school sector, then I would paint the following picture.

In the 1970s the Hessen Ministry of Education had already started to gain well-founded experience in using computers in schools by means of school- and prototype trial projects. On the basis of this knowledge a wide-spread use of computer technology in all schools with a Senior High School has been furthered.

In view of the limited financial resources, however, a state-wide equipping of schools with the necessary apparatus has evolved only step by step. The same holds true for the training of teachers: in the context of the training quotas at our disposal only 120 teachers qualify in the basics of information technology annually.

I see it as the State of Hessen's main task in the coming years, in joint effort with the towns and districts responsible for the equipment of school buildings, to further develop teaching courses and to provide the schools with contemporary equipment. The imminent introduction of videotex (visual display texts) and of cable media in the Federal Republic of Germany will provide new impulses to technological progress - with new demands made of the education sector.